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(54) Device for closing bottles and the like with screw plugs.

(57) The device comprises a sleeve (3) that is rotated around a vertical axis, coincident with the axis of a bottle (200) to be closed, and that drives a tubular shaft (10) mounted slidably along the axis of the sleeve (3). An escapement coupling means (100) is situated inside a chamber (14), defined by the tubular shaft (10), and is aimed at transmitting a tightening torque from the shaft (10) to a gripping means (22) for holding a plug (2) to be screwed on the bottle (200).

The escapement means (100) includes an upper cylindrical member (15) and a lower cylindrical member (16). The upper member is connected for rotation with the tubular shaft (10) and elastically urged by an axial force against the lower cylindrical member (16) that is axially bound to the gripping means (22). During transmission of the screwing torque, the cylindrical members (15,16) are in mutual engagement upon relative surfaces inclined with respect to the longitudinal axis and facing each other. Sensors (39,40) have the task of checking closing operation of the bottle (200).

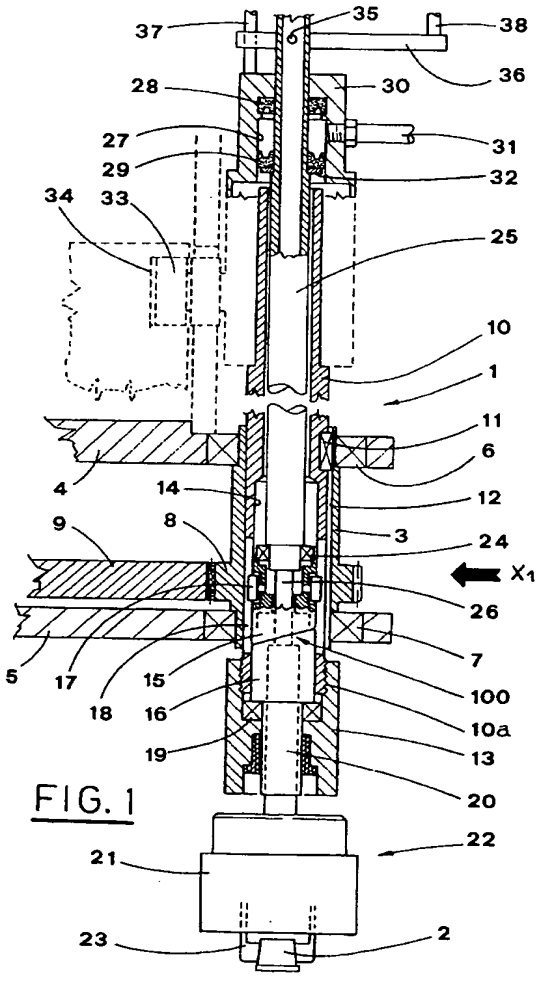


FIG. 1

EP 0 677 482 A1

The pr sent invention relates to closing bottles and the like by screw plugs.

Automatic machines are known, which carry out subsequent steps for packaging various articles, e.g. pharmaceuticals, marketed in bottles or the like.

These machines usually feature a series of carousels that during rotation carry the bottles to be packed from one working station to another. Obviously, the final step of the packaging includes closing the bottles with special caps, in particular screw plugs.

In the known machines, the high level of productivity, and therefore high working speed, have been favoured for a long time.

At present, a special attention is paid to high and constant quality. In particular, in many cases a guarantee certificate of the articles quality is required.

According to the current trend, the working steps of the machines must be properly coordinated and controlled by processing electronic means.

These processing means are aimed at checking the products characteristics that can be modified and commanding suitable operations if these characteristics vary from the programmed ones.

In the case of closing the bottles, the most obvious problem is checking the tight sealing of screw plugs, in particular checking if a predetermined tightening torque has been reached.

Actually, the product conservation can be guaranteed only if the bottle plug seals in the requested way.

This is particularly important for the products like pharmaceuticals, which are subjected to a precise expiry date.

Devices equipped with special friction means subjected to suitable elastic means, acting substantially as torque reducers, have been proposed for bottles closing control.

Of course, the above mentioned elastic means of these devices must be suitably calibrated, in relation with the desired tightening torque. However, the aforementioned devices cannot certificate the correspondence of closing of all the bottles to fixed parameters.

As a matter of fact, the system is not precise enough and little reliable, and allows only for sampling based check.

The object of the present invention is to propose a device that allows bottles and the like to be closed by scr w plugs in the best way, and to effectively check the tight sealing of these bottles.

Another object of the invention is to propose a closing device that allows to adjust, in a simple way, the tightening torque of the above mentioned screw plugs, as well as to measure continuously this tightening torque, so as to permit to give a guarantee certificate about the products quality.

The above mentioned objects are obtained in accordance with the contents of claims.

The characteristic features of the present invention are pointed out in the following description with reference to the enclosed drawings, in which:

- figure 1 shows a longitudinal sectional view of the subject closing device;
- figure 2 shows the same longitudinal sectional view of the closing device, during tightening of the screw plug on a relative bottle;
- figures 3 and 4 show a detailed view of one particular of the device, respectively from the side indicated with X1 and X2 in figures 1 and 2;
- figure 5 shows a lateral view of an upper part of the device;
- figure 6 shows a correspondent sectional view, taken along the plane VI-VI of figure 5.

With reference to the figures, the reference numeral 1 indicates the device closing bottles and the like by relative screw plugs 2.

The device 1 features a sleeve 3 that is rotatably carried, about a vertical axis, by a pair of horizontal and superimposed plates 4 and 5, by means of rolling bearings 6 and 7.

The plates 4, 5 are elements of a carousel, made to rotate about a vertical axis, in a known way. The outer part of the sleeve 3 forms a toothed wheel 8 connected with a toothed ring 9 which is integral with the fixed support structure of the above mentioned carousel.

Therefore, when the carousel is rotating, rolling of the sleeve 3 around the toothed ring 9, caused by its connection with the toothed wheel 8, makes the same sleeve 3 to rotate axially.

A tubular shaft 10, extending considerably over the upper plate 4 of the carousel, passes through the sleeve 3. The tubular shaft 10 is connected for rotation with the sleeve 3, through a suitable tang 11 which engages a longitudinal groove 12 made on the internal surface of the sleeve 3.

In its lower part, the tubular shaft 10 features a threaded section 10a for screwing another sleeve 13, coaxial with the shaft 10. A cylindrical chamber 14 is formed inside the tubular shaft 10, in its lower part, substantially in correspondence with the connection with the sleeve 3.

The chamber 14 houses an escapement means 100 that transmits the screwing motion for the plug 2. The escapement coupling means 100 includes two coaxial cylindrical members 15, 16, upper and lower respectively, having the same outer diameter.

The members 15, 16 are coupled to each other, during the screwing motion transmission, at respective facing planes, equally inclined with respect to the longitudinal axis of the d vice.

As a matter of fact, the two members 15, 16 match with each other and due to their mutual positioning, they cooperate to define a continuous cylindrical element.

The upper member 15 of the escapement cou-

pling means carries a pair of rollers 17, idling about a radial axis and situated in diametrically opposed positions.

The rollers 17 engage respective longitudinal slots 18 made on the tubular shaft 10. Therefore, the member 15 is connected for rotation with the tubular shaft 10 and is driven in rotation thereby.

The lower member 16 of the escapement means is rotatably carried by an axial bearing 19 situated inside the sleeve 13. In its lower part, the member 16 extends into a rod 20 that passes axially through the sleeve 13, and below the said sleeve 13, it is made integral with the case 21 of known gripping means 22.

The jaws 23, gripping the plug 2 to be screwed, protrude out from the lower part of the case 21 of the means 22. A tube 25, set longitudinally inside the tubular shaft 10, is aimed at urging, via an axial bearing 24, the upper member 15 of the escapement means.

The top of the tube 25 can be connected to known means for delivery of compressed air, which are not shown in the drawings. The compressed air is supplied to the gripping means 22 through a pipe 26 that extends from the lower part of the tube 25 and passes freely through the cylindrical members 15, 16 of the escapement means.

The tube 25 is pushed in axial direction by the pressure present inside a cylindrical chamber 27 defined by a jacket 30, that forms a kind of bell, and delimited by suitable tight seals 28, 29.

The tube 25 passes axially through the jacket 30 that, in its lower part, partially covers the tubular shaft 10.

The chamber 27 is supplied with compressed air by a pipe 31. The thrust exerts its action on the tube 25 by means of a ring 32 that strikes against a suitable should r formed outside the same tube.

Outside, the jacket 30 carries rolling means, indicated with sketched line 33, on a radial axis. The rolling means 33 engage a ring-like cam 34, concentric with the carousel axis and integral with the fixed structure thereof.

The cam 34 controls the axial approach of the device to the bottle to be closed. A radial arm 36, guided by a vertical shaft 37 extending from the jacket 30, is bound, by means of a transversal pin 35, to the tube 25, over the jacket 30.

The arm 36 carries a vertical bar 38 designed to operate suitable sensor means for checking closure of the bottles.

As seen in figures 5 and 6, the device is equipped with a first sensor means 39 and a second sensor means 40, constituted by e.g. conventional proximity sensors, situat d on the same horizontal plane and suitably spaced apart along to the direction A of the carousel rotation.

The sensors means 39, 40 are supported by th fixed support structure of the carousel. The sensors means 39, 40 are designed to detect passage of a flag-shaped tab 41 secured to the top of the bar 38, by a radial transverse bar 42.

The tab 41 is formed by e.g. a plate that extends for a suitable length in the carousel circumferential direction.

Operation of the device will be described, beginning from screwing the plug onto the bottle to be closed, partially seen in figure 2 and indicated by 200.

The bottle is carried by the carousel, while it rotates, below the closing device. In fact, the carousel, carries a plurality of closing devices, spaced apart along its periphery, with respective bottles to be closed aligned therebelow.

The plug 2 is held by the jaws 23 of the gripping means 22 that is driven into rotation by the tubular shaft 10 through the transmission escapement coupling means 100.

As has already been said, the shaft 10 is rotated by the sleeve 3 that is in gear engagement with the ring 9 by means of the toothed wheel 8.

Consequently, the upper member 15 of the escapement means 10, that is connected for rotation to the tubular shaft 10 by means of the rollers 17 running in the slots 18, drives the lower member 16, integral with the gripping means 22.

The upper member 15 is pushed axially due to the force applied by the tube 25, whereas the tube 25 is pressed by the pressure of the compressed air inside the cylindrical chamber 27.

It will be understood that the upper member 15 transmits tightening torque to the lower member 16 by means of the inclined opposed surfaces, in correspondence with which the members 15, 16 are coupled.

In fact, the thrust force that pushes the upper body 15, causes a transverse component force in correspondence with the above mentioned inclined surfaces, and this transverse component force gives rise to the screwing torque.

It will also be understood that the entity of the transverse component force depends on the inclination of the above mentioned connection surfaces of the cylindrical members 15, 16.

Therefore, the plug 2 carried by the gripping means 21 is screwed onto the bottle 200. After having screwed the plug 2 to the bottle 200, i.e. when a preestablished tightening torque for the plug 2 has been reached, the lower member 16 of the escapement coupling means 100 stops, while the upper member 15 continues to rotate, still driven by the tubular shaft 10.

Consequently, the upper member 15 is shifted vertically upwards, against the elastic thrust of the compressed air insid the chamber 27 (s e figure 2).

In fact, the upper inclined surface of the lower cylindrical member 16 acts as a fixed cam on the correspondent lower inclined surface of the upper cylindrical member 15 that, while rotating, slides thereonto.

When the plug 2 is screwed, the upper member 15 reciprocates upwards and downwards every turn thereof. This reciprocating movement of the member 15 of the escapement means is transmitted to the tube 25, that is supported on the same member 15 by the bearing 24; in its turn, the tube 25 drives the vertical bar 38 aimed at operating proximity sensors 39 and 40.

More precisely, the first sensor 39 detects the passage of the tab 41, carried by the bar 38 of the device, as indicated with the sketched line 41a in figure 6.

The sensor 39 supplies a reference signal, automatically compared with the signal supplied by the second sensor 40, situated downstream of the previous one, in the carousel rotation direction.

Since the vertical bar 38 does not move vertically during the plug 2 screwing step, the sensors 39, 40 d tect constant signals.

After the said tightening torque has been reached, the lower member 16 of the escapement means 100 stops and causes vertical reciprocating movement of the bar 38.

Therefore, at this step, the top of the bar 38, carrying the tab 41, moves over the sensors 39,40, as the sketched line 38a in figure 5 shows.

In practice, the sensors 39, 40 detect an alternate signal which indicates that the pre-determined tightening torque for the plug has been reached, i.e. the bottle 200 has been tightly closed.

Obviously, the sensors 39, 40 allow for detaching possible failure during the plug screwing.

In particular, if the constant signal, determined by the immediate alternate movement of the bar 38, is not received, it means that the plug has not been screwed regularly, e.g. because the plug has jammed.

Lacking of the alternate signal means that the bottle 200 has not been completely closed e.g. because of plug defect.

Obviously, under these conditions, the faulty closed bottle is discarded, so as to choose only the products corresponding to the predetermined characteristics.

Consequently, the described device allows to check the bottles real tight seal closing operation in which screw plugs are applied thereto, immediately rejecting possible defective bottles.

It is to be pointed out that all the bottles packaged by the machine are checked, so that it is possible to att st the correspondence of the closing characteristics of all the bottles to the predetermined parame t rs.

Moreover, the device also allows to suitably adjust the value of the plug tightening torqu . For this purpose, it is made possible to change the value of the pressure inside the chamber 27, that determines the value of the axial thrust acting elastically on the escapement coupling means 100 transmitting the tightening torque for the plug.

It is obvious that this pressure can be controlled by suitable sensors, so as to have an indirect measure of the tightening torque value.

The subject device allows to close the bottles with screw plugs in best way, permitting in particular to check the actual tight seal closure of the bottles.

Moreover, the closing device allows the plugs tightening torque to be adjusted in a simple way and to be measured continuously.

All this makes it possible to issue a guarantee certificate attesting the packaged products characteristics.

Finally, the closing device is simple in its construction and versatile to be adapted in accordance with the features of the bottles to be closed.

Claims

1. Device for closing bottles and the like by means of screw plugs, characterised in that it comprises
a sleeve (3) rotating about a vertical axis coincident with the axis of the bottle (200) to be closed;
a tubular shaft (10) driven into rotation by the said sleeve (3) and mounted with possibility to slide axially relative to the same sleeve (3);
a chamber (14) defined by the said tubular shaft (10) ;
an escapement coupling means (100) situated inside the said chamber (14) for transmitting a tightening torque from the said tubular shaft (10) to means (22) for gripping a plug (2) to be screwed onto the said bottle (200), said escapement means (100) including an upper cylindrical member (15) connected for rotation with the said tubular shaft (10) and urged elastically by an axial force, and a lower cylindrical member (16) bound axially to the said gripping means (22), said cylindrical members (15,16) being in coaxial relation with each other, and aimed at being coupled with each other for transmission of the tightening torque to the said plug, the coupling occurring at respective surfaces inclined with respect to the said longitudinal axis and facing each other;
sensor means (39,40) aimed at checking closing operation of the said bottle 200.

2. Device according to claim 1, characterised in that the said lower cylindrical member (16) of the escapement coupling means (100) stops when the plug (2) on the said bottle (200) has reached a predetermined tightening torque, while the said upper member (15) continues to rotate, driven by the said tubular shaft (10).

3. Device according to claim 1, characterised in that the said upper cylindrical member (15) of the escapement coupling means (100) is urged axially, via bearings (24), by a tube (25) introduced longitudinally inside the said tubular shaft (10) and pushed elastically by a pressure present inside a cylindrical chamber (27) defined by a jacket (30), through which the same tube (25) passes.

4. Device according to claim 3, characterised in that the said tube (25) carries a vertical bar (38) designed to activate the said sensor means (39,40) for checking the bottle (200) closing operation.

5. Device according to claim 1, characterised in that the said sensor means includes a first sensor (39) and a second sensor (40), arranged stationary on the same horizontal plane and suitably spaced apart along the rotation direction (A) of a carousel carrying the device.

6. Device according to claim 1, characterised in that the said sensor means (39,40) detect the passage and vertical movement of tabs (41) carried by means (25,38) aimed at following the movement of the said upper cylindrical member (15) of the escapement coupling means (100).

7. Device according to claim 1, characterised in that the said sensors (39,40) are aimed at detecting the passage, at a stationary axial position, of the said tabs (41) during the plug (2) screwing step, and at detecting reciprocating vertical movement of the same tabs (41) when the pre-determined tightening torque has been reached.

8. Device according to claim 1, characterised in that the said upper cylindrical member (15) of the escapement coupling means (100) has diametrically opposed rollers (17) rotating about a radial axis and aimed at engaging respective longitudinal slots (18) made in correspondent positions on the said tubular shaft (10), so that the said upper cylindrical member (15) can slide vertically with respect to the same shaft (10), against the said axial force, when the pre-determined tightening torque has been reached.

9. Device according to claim 1, characterised in that the said lower cylindrical member (16) of the escapement coupling means (100) is rotatably supported on rolling means (19) housed inside a further sleeve (13) secured to the lower end of the said tubular shaft (10), and extends axially into a rod (20) that is made integral with the said gripping means (22).

10. Device according to claim 1, characterised in that the said cylindrical members (15,16) of the escapement coupling means (100) have cylindrical shape and are axially crossed by a tube (25) situated inside the said tubular shaft (10) and connected at the top with means for delivering compressed air used to feed said gripping means (22), the said tube being also designed to transmit the axial thrust to the said upper cylindrical member (15).

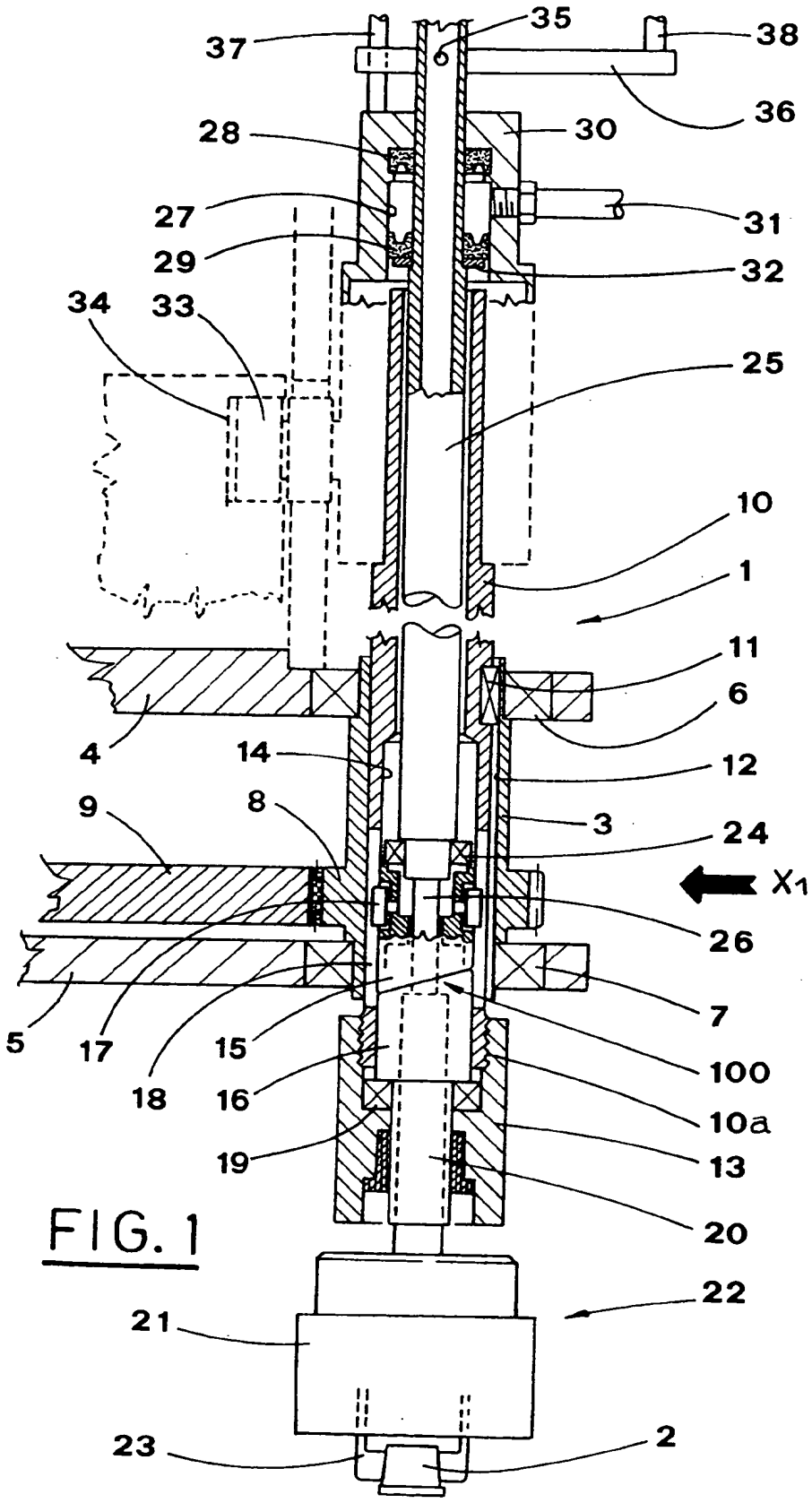
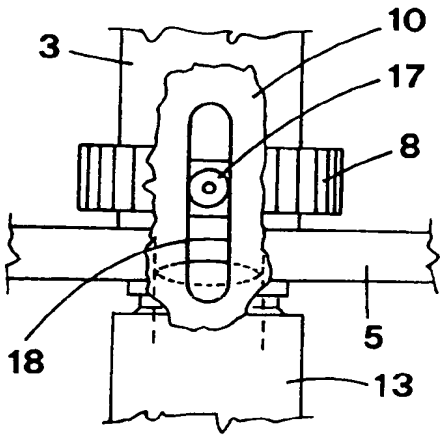


FIG. 1

FIG. 3



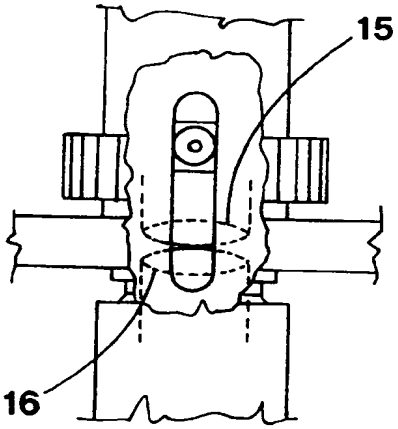


FIG. 4

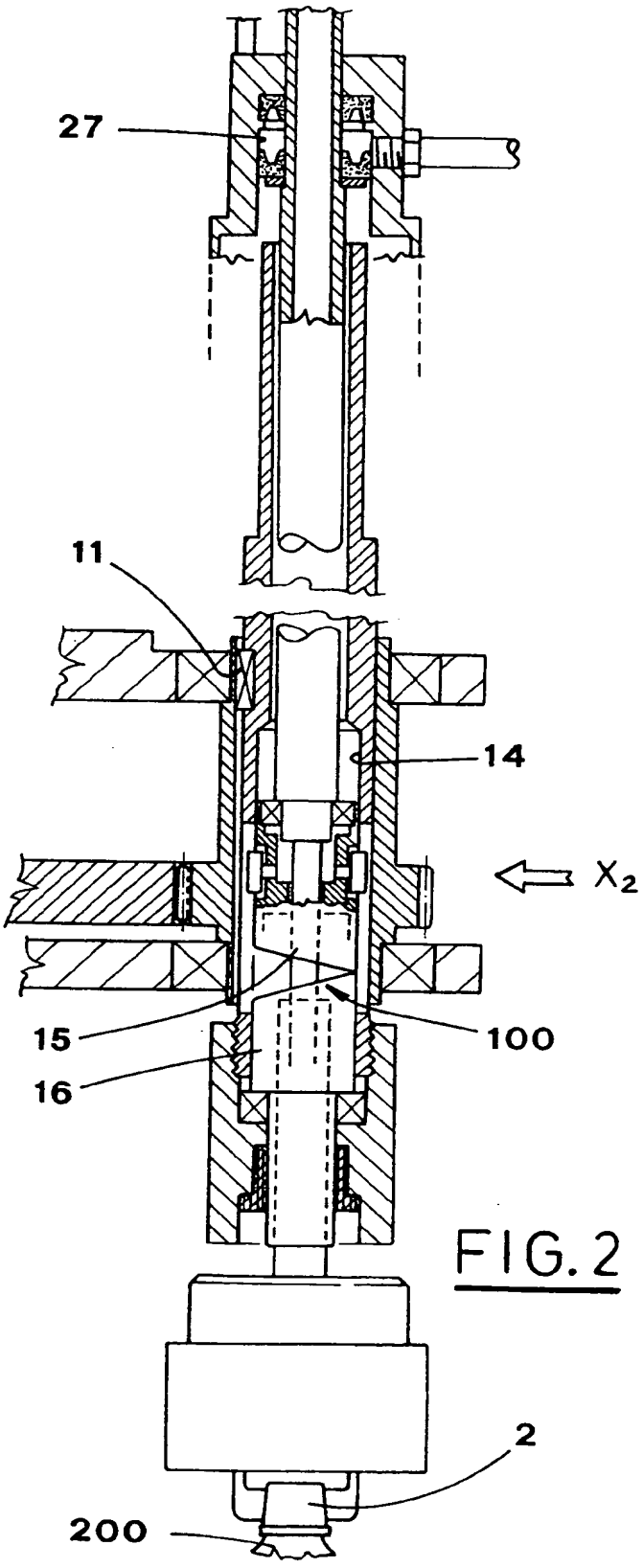


FIG. 2

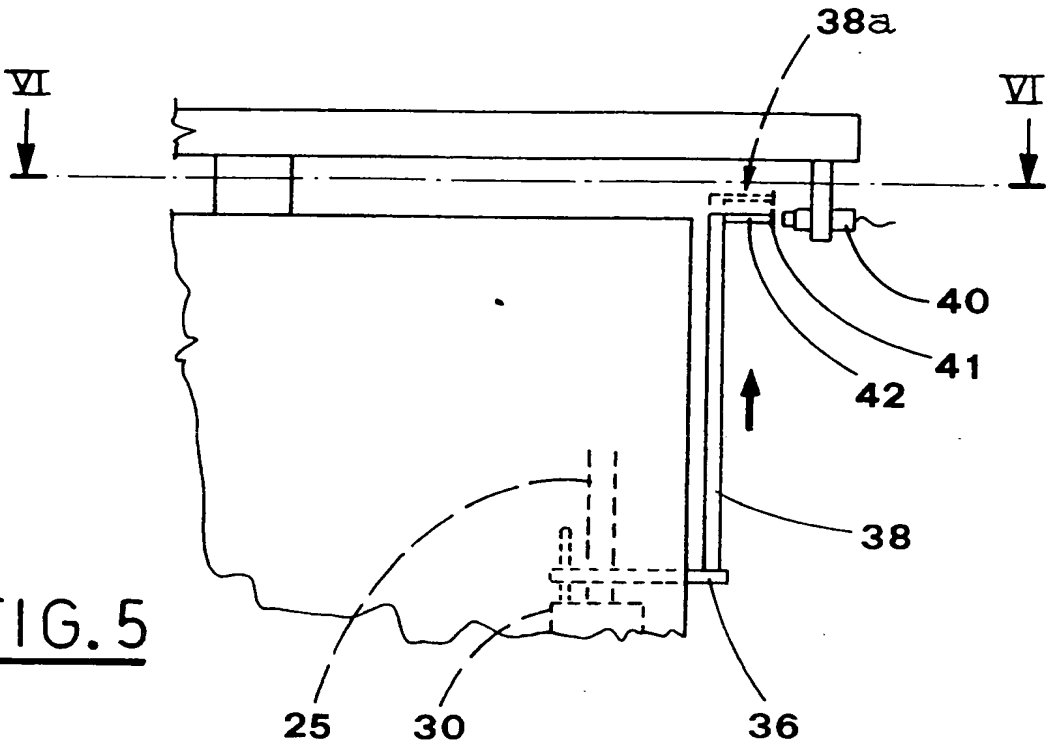


FIG. 5

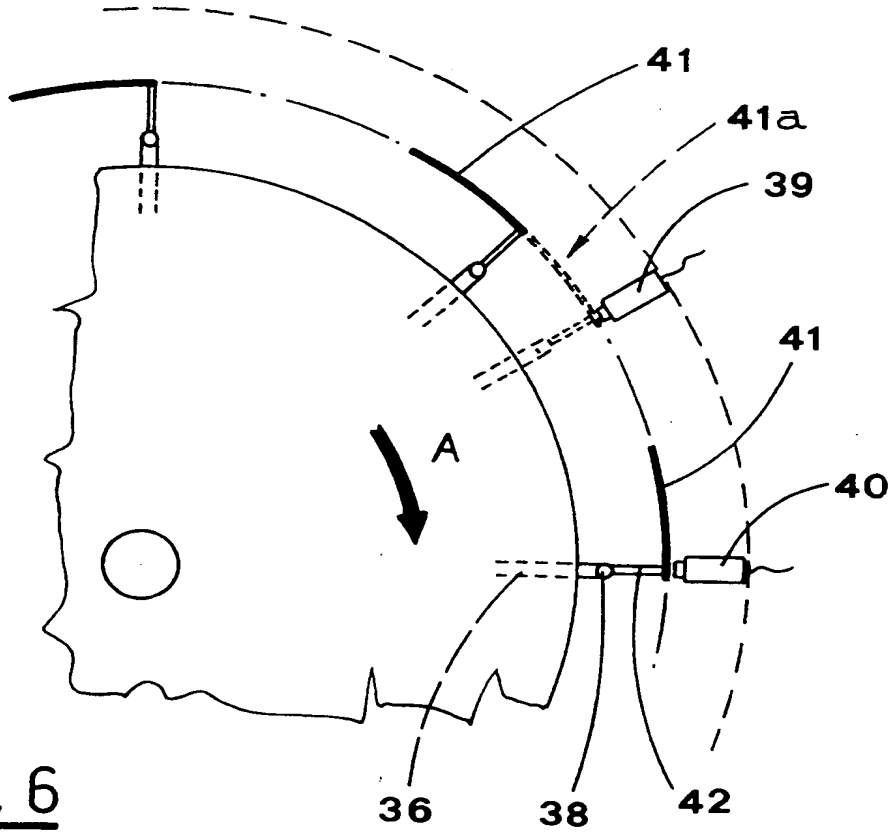


FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 83 0142

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US-A-2 760 391 (KNUTSON) * column 2, line 33 - line 43; figures 2,5,6 *	1	B67B3/20 B67B3/26
A	EP-A-0 534 777 (SHIBUYA KOGYO CO., LTD)	1	
A	US-A-2 449 161 (CRAIG ET AL.)	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B67B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 July 1995	Martínez Navarro, A.

CATEGORY OF CITED DOCUMENTS

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